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Willingness to Pay for Reduced Accident Risk for Children: Inferences from the Demand for Bicycle Safety Helmets

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Abstract: This paper develops a household production model in which parents produce bicycling safety for their children. Using data from the National Survey on Recreation and the Environment, via a random utility model, we estimate conditional indirect utility as a function of bike safety and infer WTP for reduced risk of fatal and non-fatal head injury. We estimate parental values for reducing biking risks faced by their children. We obtain estimates of parental values for children that include a VSL of $9.5 million and a VSI of $7.0 million.

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1. Introduction

Improving children's health is a relatively new federal priority. The Clinton Administration's Executive Order (E.O.) 13045 directs policy makers to examine and reduce health and safety risks to children. This directive has led to a new need for more accurate measures of the benefits of policies that improve children's health; more specifically, for better estimates of the economic value of reducing childhood risks. To date, the economics literature contains only a handful (albeit a growing handful) of such estimates, whereas it contains a multitude of estimated values of reducing risks to adults. Thus for policy applications, at present, analysts must choose between two practical but conceptually lacking alternatives for child health values. The first is to rely on estimates of the medical costs associated with an illness. The second is to transfer estimates of willingness-to-pay (WTP) for risk reductions estimated for adults to child populations.

The first approach has been labeled "cost-of-illness" and usually involves estimates of direct medical expenditures and of the more indirect cost due to lost work time (or for children, future lost work time). Conceptually, the cost-of-illness approach simply measures ex post costs and does not attempt to measure the loss in utility due to pain and suffering or the costs of any averting behaviors that individuals have taken to prevent an illness. Some consider a cost-of-illness estimate to be a lower bound estimate of WTP because it fails to account for many effects of disease, such as lost leisure time or pain and suffering (Harrington and Portney 1987; Berger et al. 1987). Others suggest that cost-of-illness might exaggerate risk values since in some cases the cost of averting behaviors that prevent a medical condition can be far less than the ex post costs of treatment (insert cite). Economists widely recognize that the preferred measure to assess the benefits of federal policy is to estimate WTP for ex ante risk reduction rather than using cost-of-illness estimates (U.S. EPA 2000).

Due to a lack of WTP estimates for children, at present analysts routinely transfer WTP estimates for adult risk reductions to child populations. The appropriateness of these transfers is questionable (Dockins et al. 2002; Agee and Crocker 2003). Researchers are currently asking whether a risk reduction of the same character and size should be valued differently when experienced by children as compared to adults. This paper is a first step in shedding light on this issue by estimating parental values for reducing the risk of a bicycle injury to their children. In a future paper, the authors will estimate adult values for reducing the same risk to themselves and compare the values.

Many of the estimates of adult health and safety values have been derived via hedonic wage analyses. For obvious reasons, this methodology is not viable for analysts focused on children or for analysts seeking insight regarding the differences between adults and children. A valuation alternative that does hold promise, however, is analysis of safety product markets.

Of particular promise is the bicycle helmet market. A bike helmet is a personal safety product whose ownership is generally assigned to a single individual, not to a family or some other group which would render it impossible to assign the benefits of the safety product to one person. In addition, bike helmets are owned by young and old alike leaving open the possibility of discerning a relationship between age and willingness-to-pay for safety. This paper and future work will take advantage of these desirable attributes of the bicycle helmet market by examining households' purchase decisions regarding helmets for adults and children. We develop a household production model in which adults produce bicycling safety for themselves or parents produce it for their children. Via a random utility model, we estimate conditional indirect utility as a function of bike safety and infer WTP for reduced risk of fatal and non-fatal head injury. We estimate parental values for reducing biking risks faced by their children and, in the future, we will estimate adult values for reducing their own risks.

Data were obtained from a telephone survey that was part of the most recent National Survey on Recreation and the Environment. Respondents can be separated into two groups: parents who report having a child age 5 to 14 who had bicycled within the previous 12 months, and adults age 20 to 59 who report having bicycled themselves within that same time frame. In addition to socioeconomic information, we have information on the amount of bike-riding, the perception of helmet laws, the importance of helmet features and the price paid for the helmet. Data on the risk of bicycling is obtained from the Centers for Disease Control (CDC) and varies according to age, gender and race.

Previously in the economics literature, analyses of safety product markets have estimated the value of risk reduction by assuming that the marginal benefit of risk reducing activities equates with their marginal cost. These papers have lacked price information and have based estimates of the value of risk reduction solely on estimates of implicit values (and amounts) of time and/or on estimates of monetized dis-utility (Blomquist 1979 and 1991; Blomquist, Miller and Levy 1996; Carlin and Sandy 1991). Other product market analyses estimate lower bound values of risk reduction based directly on highly aggregated product prices (Dardis 1980; Garbacz 1989; Jenkins, Owens and Wiggins 2001). The current paper adopts a different approach, one developed outside the safety product literature. Dickie and Gerking (1991) and Agee and Crocker (1996) develop household production models in which utility depends upon health or risk of family members. The household makes many unobserved choices regarding the production of health or risk but there is one observable discrete choice, such as whether or not to purchase medical care. The probability of the discrete choice is estimated via a random utility model with which welfare effects can be computed (Small and Rosen 1981). For the current paper, the discrete choice is whether or not to purchase a helmet.

To estimate how consumer WTP for risk reduction varies with the age of the beneficiary requires an ability to discern the age of the beneficiary. Previous analyses have examined spending on safety products that benefit an entire household -- smoke detectors (Dardis 1980, Garbacz 1989) and automobile size (Mount et al. 2000) -- or that benefit only children or only adults -- car safety seats and motorcycle helmets (Carlin and Sandy 1991; Blomquist 1991; Blomquist, Miller and Levy 1996). Our analysis is unique in that bicycle safety helmets are used by all age groups but are purchased for specific individuals. This allows us to estimate separately the WTP for bicycle safety for children and adults.

The choice of whose preferences to rely upon to determine the value of childhood risk reductions is an important one. Dockins et al (2002) suggests that the parental perspective is advantageous for multiple reasons.[1] The current paper examines parental decisions regarding bicycle safety, specifically regarding the purchase of a child bicycle helmet. Also reported by parents are other variables in the demand function for helmets, such as the perception of helmet laws and the amount of time a child spends riding. Thus, for children's safety, we estimate a parent-determined WTP.

The following sections of the paper develop a model of household production and then translate propositions from the model into empirically testable form. We describe the data that we analyze and the tentative results that we obtain via a logit model of the purchase decision.

2. Household Production Model

This section presents a household production model of utility from which we derive the compensated demand for bicycle safety helmets. The household perspective is chosen in order to represent helmet purchase decisions made by parents for their children. However, the model can be easily adjusted to represent adults making decisions only for themselves, without explicit consideration of children. The model will illuminate the important underlying variables in the discrete choice decision of whether or not to purchase a helmet. The model also provides structure for the estimation of risk valuation. We derive from the model an equation to represent adult willingness to pay for own risk reduction as well as parental willingness to pay for child risk reduction. This section draws heavily from household production and random utility models developed by Dickie and Gerking (1991), Agee and Crocker (1996) and Agee, Crocker and Shogren (2001), which in turn drew from Small and Rosen (1981).

Parents derive utility, U_p, from consumption of commodities and activities, Z_p, produced for themselves, and from the risk they perceive themselves as facing by riding a bicycle, R_p. Parents also derive utility from commodities and activities, Z_c, produced for each of their $i = 1, ..., n$ children and from the risk they perceive their children face, R_c, from bicycling. If we represent a single-period, two-generation family in which children's utility is additive to parents' utility but separable, then:

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[1]Four possible perspectives for valuing children's risk reductions are suggested by Dockins et al. (2002): that of society, the child, adult-as-child, and parent.

$$U_p = u_p(Z_p, R_p) + \sum_{i=1}^{n} \alpha_{pi}(\gamma) u_{ci}(Z_{ci}, R_{ci}), \qquad (1)$$

where $U'_z \geq 0$ and $U'_R < 0$. $U_p(.)$ is quasi-concave and increasing in at least some of the Z's, and is finite whenever some of the Z's are zero (Small and Rosen 1981). Parents combine their time, effort and market good purchases to produce child-related commodities, Z_c. The u_p and u_c functions differ because children and their parents experience their environments differently. The multiplier $\alpha_{pi}(.)$ converts child i's utility into his parents' utility and depends on γ which represents family characteristics that affect the conversion of childhood utility into parental utility.

Parents also combine their time, effort and market purchases to affect the level of risk, R, faced by themselves and their children from riding bicycles:

$$R_j\left(D_j, H_j, b_j, \gamma\right)_{j=p,c} \qquad (2)$$

where D represents the amount of time spent riding a bicycle, H represents the use of a bicycle safety helmet, b is the level of risk per unit of riding time, assuming no helmet-wearing, that is expected for the rider and varies according to the risk taking behavior of the individual, and γ represents any family characteristics, such as parents' educations, which may influence risk perception. As mentioned already, helmets are unique in their ability to reduce by significant proportions the risks of injury and death from bicycling. Spending on helmets produces nothing of value other than reductions in R.

Let q denote a vector of market prices for commodities and activities; t denote a vector of parental time inputs, and t_s denote time spent away from paid work. Then the parental income constraint can be written as a sum of expenditures on own and children's consumption,

$$Y_p = r_p Z_p + r_{hp} H_p + \sum_i \left(r_{ci} Z_{ci} + r_{hci} H_{ci}\right) \qquad (3)$$

where $r_j = (q_j + wt_j)$; $j = p, c, hp, hc$; and $w = Y_p/(T-t_s)$ so that parents' income, Y_p, determines their opportunity cost of time, w. Parents choose t_j, R_p, Z_p, R_c and Z_c to maximize total utility in (1) subject to (2) and (3).

Assume that parental WTP is the largest income that parents must forego after a reduction in expected risk, to maintain ex ante expected utility. Parental WTP estimates the value to the household of a reduction in the level of risk, b, that the rider is expected to face. Let $V_p(.)$ denote the parents' indirect utility function from the above utility maximization problem. Given the properties of expression (1), $V_p(.)$ is continuous and strictly increasing in household income, Y_p, and thus can be inverted to find the expenditure function, e[.], satisfying

$$U_p = V_p\left(r, D, b, \gamma; e\left[r, D, b, \gamma\right]\right). \qquad (4)$$

Differentiating (4) with respect to b yields adults' or parents' marginal willingness to pay for a reduction in the expected riskiness in either their own or their child's bike riding activity.

$$MWTP_b \equiv \partial e / \partial b = -(1/\lambda)\partial V_p / \partial b, \qquad (5)$$

where $\lambda \equiv \partial V_p/\partial Y_p$ is the marginal utility of income.

Expression (5) portrays parents' marginal disutility of the expected risk of bicycling converted to monetary units via the marginal utility of income. In general, this measure is empirically intractable because actual utility levels are not observed. However, an empirical representation is available via a discrete choice model of the decision to purchase a bicycle helmet.

The household production model portrayed in (1) through (5) can be adjusted to represent adults making decisions for themselves without explicit consideration of children by assuming $Z_{ci} = 0$ and $R_{ci} = 0$ for all i.

3. Empirical Model

A parent's decision to purchase a helmet or not is a discrete choice based upon information about the risk reduction provided by helmets. Let $\bar{v}_H$ denote the maximum attainable expected utility if a helmet is purchased and let $\bar{v}_O$ denote the maximum attainable expected utility if a helmet is not purchased. For households characterized by b and γ, the choice to purchase a helmet or not is made by comparing these two expected utility levels, given income, Y_p, and a wage-price vector, $r = (w, q)$:

$$\begin{aligned} H &= 1 \text{ if } \bar{v}_H - \bar{v}_O > 0 \\ H &= 0 \text{ otherwise.} \end{aligned} \qquad (6)$$

The utility difference is specified econometrically as

$$\bar{v}_H(.) - \bar{v}_o(.) = X'\beta + \varepsilon \qquad (7)$$

where X is a vector whose first element is unity and whose remaining elements measure arguments of the conditional utility function in (4), β is a parameter vector and ϵ is a random error component. The probability of purchasing a safety helmet, conditional on ϵ, is

$$\Pr(H = 1) = F(X'\beta + \varepsilon), \qquad (8)$$

where $H = 1$ if a helmet is purchased and 0 otherwise, and $F(.)$ is the symmetric distribution of V conditional on ϵ.

Let $\bar{X}'\hat{\beta}$ be the inner product of explanatory variables and estimated coefficients, with each explanatory variable except risk set equal to its sample mean. Assume that ϵ is distributed standard logistic and note that bicycle expenditures are a small part of the family budget. Then, following Small and Rosen (1981) if the compensated demand for a bicycle helmet is approximated by its Marshallian counterpart, parents' $MWTP_b$ in expression (5) is approximated by

$$MWTP_b = -(\hat{\beta}_b / \hat{\lambda}) F(\bar{X}'\hat{\beta}), \qquad (9)$$

where $\hat{\beta}_b$ is the estimated coefficient for risk, $\hat{\lambda}$ is the estimated marginal utility of income, $F(.)$ is the standard logistic cumulative distribution function and $F(\bar{X}'\hat{\beta})$ is the estimated probability of purchasing a helmet.

Helmets seem essential to reducing the risk of head injury from bicycle riding thus the concern shown by Bockstael and McConnell (1983) that (9) will yield an incomplete measure of the true $MWTP_b$ in (5) is lessened.

4. Data Description

The primary data source for this work is the 2000 National Survey on Recreation and the Environment (NSRE), conducted by the U.S. Department of Agriculture's Forest Service. Other data we relied upon includes income and population data from the U.S. Census Bureau, weather data from the National Climatic Data Center, and pedal cycle injury and death statistics from the Centers for Disease Control and Prevention (CDC).

The NSRE is a random-digit-dialed phone survey of U.S. residents over age 16. The survey collected information from the American public on demographics, participation in a multitude of outdoor activities, and opinions concerning environmental and natural resource issues. Between July 2000 and July 2001, the NSRE asked respondents questions related to bicycling, especially regarding bicycle helmet purchases and use. Respondents were either asked a series of questions related to their own bicycle helmet purchasing decisions (adult module) or, if the respondent had a bike riding child between the ages of 5 and 14, questions related to purchasing decisions for that child's bicycle helmet (child module). Respondents were asked about the amount of bike riding they (or their child) did, their beliefs regarding the existence of helmet laws, the price they or another family member paid for their (or their child's) helmet, the factors influencing their choice of helmet, their (or their child's) expected helmet use patterns at the time of purchase and a question to determine if the respondent would have changed their helmet purchase decision after being given accurate information on the risk reduction provided by helmets.

In order to maximize the number of responses to the bicycle helmet modules subject to a constraint on the length of each interview and because of the anticipated difficulty contacting respondents with bike riding children of an appropriate age, most of the respondents were asked the child module first. The first question in the child module asked if the respondent has a bike riding child between the ages of 5 and 14. An affirmative answer to that question led to the remaining questions in the children's bike helmet module. If the respondent did not have any bike riding children of an appropriate age, the questions in the adult bike helmet module were asked. A concern that we were not getting responses to the adult questions from any parents who had bike riding children led to approximately 100 interviews in which respondents with bike riding children were also asked the adult questions.

The initial data set included 15,010 observations.[2] After eliminating observations for respondents who did not ride a bicycle in the past year or have a bike riding child between the ages of 5 and 14[3], the samples contained 2,463 respondents with a bike riding child between the ages of 5 and 14, and 1,493 adult respondents who rode bikes themselves. Observations with missing data values for variables included in our regression analysis were eliminated, as were observations where the respondent (or her child) had a helmet, but the helmet was not purchased

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[2]The data set comes from versions 5, 7, and 9 of the NSRE which contain the adult and child bicycle helmet modules.

[3]Observations were eliminated from the data set if income was greater than $4 million (this eliminated the few income observations that were greater than 3 standard deviations from the mean); if the respondent answered that his or her helmet would last over 50 years; if the respondent was less than 19 years old; and for the child questions, if the parent age minus the child's age was less than 15.

by herself or an immediate family member.[4] In order not to lose those observations where household income was the only relevant variable that was missing, we used data from the 2000 Census[5] to create a proxy income variable. Proxy income is equal to the median family income by race for the zip code in which the respondent lives. If the respondent lived alone or in a house with roommates, proxy income is equal to the mean individual income by race for his or her zip code. The final data set used for our analysis includes 1,984 child observations and 941 adult observations. Means and standard deviations of the data for children are summarized in Table 1.

Of the 1,984 child observations, 89.5% were helmet purchasers. These numbers are similar to a 1999 U.S. Consumer Product Safety Commission (U.S. CPSC 1999) survey that found 84% of bike riding children under 16 own a helmet.

About 12% of the U.S. population is covered by state or local helmet laws (BHSI 2001). All 20 of the state laws are specific only to children and 30 of the 83 local laws apply to all ages, with the others being specific only to children. Interestingly, 52% of the respondents in our child sample said that there was a law in their community or state requiring children to wear bicycle helmets and 17% said they did not know whether there was a law applicable to children. People may believe that a helmet law exists in their community when they are exposed to a helmet education campaign. For example, McDonald's Corporation ran a national campaign encouraging helmet use for children and adults. Whether the respondents are correct in their knowledge of helmet laws in their community or not, it is their perception of the law that will drive their helmet purchasing decisions.

The federal safety standard for bicycle helmets (U.S. CPSC 1998) ensures that all bicycle helmets manufactured after March 10, 1999 must meet a minimum level of safety. It is unlikely that manufacturers would create helmets that go too far beyond this standard. To make a helmet safer than the federal standard would require additional cost to the manufacturer, but also more weight and size to the helmet making it less likely to be bought or worn (U.S. CPSC 1998). Even though helmets themselves do not differ significantly in their levels of protection, different levels of risk-taking behavior or exposure to risk during riding will cause individuals to face different risk reductions provided by their helmets. The CDC reports annual pedal cycle deaths and injuries by age, race, and gender. We combine this data with information on population and the percent of population that rides a bicycle in order to assign a fatal and non-fatal risk measure to each

[4]In this situation, respondents were not asked further helmet questions because it is unlikely they would have known the helmet purchase price or other factors that went into the purchase decision.

[5]Data was obtained from Census 2000 Summary File 1 and Census 2000 Summary File 3 (http://www.census.gov/main/www/cen2000.html - accessed May - June 2003).

individual in our sample that is equal to the average for that individual's age-gender-race group.[6]

5. Empirical Implementation

We estimate a purchase equations representing parents' purchases of helmets for children. The indirect utility function in (4) suggests that the purchase decision depends on a variety of variables including the wages of the family and the price of the helmet. We combine these two variables and include in the equation one variable measuring household income less the helmet price. To measure the amount of time spent riding, D, we include a variable indicating the number of days ridden by the bicycler during the previous 30 days. Since the prevailing weather during the month in which the survey was administered would influence the number of days a bicyclist might ride, we also include the average temperature during that month and a term that interacts avidity with temperature. We include separately both the rate of death and the rate of injury to measure the risk of bicycling. To represent the attributes of families, γ, that either affect the conversion of childhood utility into adult utility or affect risk perception we include a variety of socioeconomic information: age, gender, race and education of the bicycler and/or his parents. (For the child equation we substitute parent's education for rider's education and we include an indicator variable for whether the parent respondent rode. For age, we include both the parent's age and the child's.) Finally, we include two indicator variables that indicate whether the respondent believed that there was a helmet law requiring use or whether the respondent was unsure.

Table 2 presents the results of four logit models of the decision to purchase a helmet for children and adults. The first column gives the primary results. The sign of the coefficient on the child's age is positive, in agreement with the burgeoning consensus among studies targeted at children that parent's valuation of risk reduction varies inversely with child age (Agee and Crocker 2003). The suggestion is that as a child ages through middle childhood, the probability that a bike helmet will be purchased for him declines. Similarly, parents of male children are less likely to purchase a helmet. This could indicate a greater parental acceptance of risky behaviors undertaken by boys compared to girls or undertaken by older children compared to younger ones. Alternatively, parents of boys and older children might have lower expectations regarding their children's compliance with parental wishes for the child to wear a helmet. Parents would naturally be reluctant to purchase a helmet that they believe it will not be worn.

The probability that a helmet will be purchased for a child increases if the respondent believed there was a law requiring helmet usage or if the respondent was unsure about the presence of a helmet law. This finding bodes well for the recent dramatic increase in popularity of helmet laws for youngsters. Parents really are responding to such laws. However, parents also

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[6]For the child observations, we assume that the race of the child is the same as the race of the respondent.

respond positively to uncertainty about the existence of a law.

As expected, greater household income positively affects the probability that a parent will purchase a helmet for her child as does greater education level. The indicator variables for black and white race are significant and negative. Relative to households of other races (Asian, Pacific Islander, American Indian and others) these households are less likely to purchase a helmet for their child. The indicator variable for whether or not the parent rides a bike is significant and positive suggesting a greater awareness of bike safety issues by parents who themselves bike.

A parent's age is not correlated with the probability of purchasing a helmet. The indicator variable for whether or not the parent rides a bike is significant and positive suggesting a greater awareness of bike safety issues by parents who themselves bike. As expected, the rate of death and injury faced by the child as a consequence of bicycling is positively and significantly associated with the probability of purchasing a child's helmet.

In addition to the primary model described above, we estimate three additional logit models. To check the sensitivity of the results to the rather rough measure of avidity represented by the number of days ridden and the temperature variables, we re-run the logit and omit those three variables in specification (2), and omit just the two temperature variables in specification (3). The results are robust. Finally, we wished to include measures of the importance to the respondent of the helmet's appearance and comfort level. We include two variables indicating whether the respondent believed these features of the helmet were important in specification (4) and find that neither is significant, nor does their inclusion alter substantially the coefficients estimated for the remaining variables.[7]

Our principal purpose is to approximate parental WTP for child risk reduction. To do this we estimate for each respondent the percentage change in income necessary to keep utility constant when bicycling risk is reduced by one percent. This is achieved by evaluating equation (9) and converting to percentage terms. For specification (1) the resulting values of statistical life and injury for children are \$9.5 million and \$7 million, respectively. These estimates vary between \$8.9 and \$9.9 million for VSL and \$7 and 8.4 million for VSI among the four specifications.

6. Discussion

These estimates of VSL for children are higher than most VSL estimates reported in the literature for adults. A good summary estimate of a set of high quality, policy relevant adult VSL studies is provided by the EPA. To analyse proposed regulations, EPA relies on a VSL estimate

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[7]The appearance and comfort variables are constructed with responses to questions in the survey regarding the importance of comfort and appearance and with the days ridden variable thus we omit direct measures of days ridden and temperature from specification (4).

of approximately $6 million (in 2000 dollars). This estimate was derived by fitting a Weibull distribution to 26 adult VSL studies (21 that use the hedonic wage method and five that examine stated preferences). The suggestion is that parents value reductions in risk to their children by more than adults value reductions in risk to themselves. However, this suggestion is made with caution since there are important differences between the nature of the risk being examined and the valuation estimation methodology in the current study compared to the adult studies. In the future, we plan to estimate adult willingness to pay for reductions in bicycle risk and will more confidently make direct comparisons to our estimates for children.

Our VSL estimates for children are quite high relative to the two values for children found in the published literature: between $0.75 million (Carlin and Sandy 1991) and $4.0 million (Jenkins, Owens and Wiggins 2001)[8] However, these two studies were examinations of direct time and/or money expenditures on safety products. So, again the methodology is different enough to suggest caution in making comparisons.

To get an idea of the relative magnitude of the VSI estimates, we gathered information about the medical costs of non-fatal bicycle injuries in the U.S. A review of hospital discharge data in Washington state (1989-1991) found that treatment for nonfatal bicycle injuries among children ages 14 and under costs an average of $218,000 per injured child (Bicycle Helmet Safety Institute 2003). A cost of illness (COI) estimate would add to these direct costs, such indirect costs as the value of the parent's lost work time from caring for the sick child and the value of future lost wages due to any brain injury or long term debilitating injury to the child. Even after accounting for these indirect costs, the COI of non-fatal bicycle injury would be far less than our VSI estimates. Dickie and Gerking (1991) also obtain estimates of WTP that are higher than corresponding medical costs. Using a similar model and empirical method as in the current paper, the estimates of WTP for ozone control turn out to be about double the medical expenses associated with treating respiratory illness that is associated with ozone pollution. While the magnitude of the difference is much smaller, these findings and ours give examples when estimates of WTP are substantially higher than comparable COI estimates. The unmonetized costs such as pain-and-suffering might be the explanation.

On the other hand, the opposite is suggested by the WTP estimates inferred from demand functions for chelation therapy to reduce child lead burdens. Agee and Crocker (1996) estimate parental WTP for a 1 percent reduction in child lead burden as falling between $11 and $104. Lutter (1994) converts these WTP estimates into estimates of the value of a lost IQ point and obtains values that range from $1,100 to $1,900. Lutter compares these parental WTP estimates to government COI estimates of lost income due to lowered IQ and finds the latter to be much higher, approximately $8,800 per lost IQ point.

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[8]These estimates are in 1997 dollars. The estimate for Jenkins, Owens and Wiggins (2001) is the upper limit of a range beginning at $1.1 million.

Dockins et al. (2002) attribute this difference to the fact that the WTP estimates represent the parental viewpoint while the COI estimates represent a lower bound of what a child should be WTP him or herself (if lending constraints were relaxed). Our own paper suggests that parental WTP for children is actually much higher than COI. The nature of the risks being valued by the two studies is quite different. Children with high body burdens of lead exhibit long-term cognitive and adaptive behavior deficits. In the short term, effects include hyperactivity, poor attention and learning problems. Risks of bicycling include catastrophic brain injury, concussion and contusion. A second important difference between the two studies is the education and income levels of parents in the study sample. Parents in the Agee and Crocker (1996) study had an average education level of 11 years and an average income of only $17,000 (1985 dollars). Almost 70 percent of our sample went to college and they earn an average of $60,000 (2000 dollars). Thus the Agee and Crocker paper examined a risk that imposes intangible effects, the most devastating of which are in the distant future, and estimated the WTP to reduce this risk among relatively low income parents. The current paper examines a risk that poses a dramatic immediate physical threat and estimates WTP among relatively high income parents. In light of these difference, the larger gap between WTP and COI for non-fatal bicycle injury is easier to understand.

In a future version of this paper, we will estimate a logit equation representing adult's helmet purchase decision for self. This will enable us to compare values of risk of the same nature and similar magnitude for children and adults.

Table 1
Means of Variables for Child Bicyclists
(Standard deviations are in parentheses)

	children (n=1984)

Own	0.895 (0.307)
Age	9.513 (2.871)
Parent's Age	38.855 (7.650)
Male	0.534 (0.499)
Helmet Law - Yes	0.519 (0.500)
Helmet Law - Don't Know	0.171 (0.377)
Household Income Minus Price($1000)	58.247 (39.635)
Black	0.088 (0.284)
White	0.887 (0.316)
Parent Rides	0.583 (0.493)
Highschool	0.284 (0.451)
College	0.671 (0.470)
Days Ridden	11.008 (10.937)
Fatal Head Injury Risk	5.300 E-6 (3.669 E-6)
Non-Fatal Head Injury Risk	3.083 E-3 (1.488 E-3)
Monthly Mean High Temperature (degrees)	62.413 (20.974)

Table 2 Econometrics Results for Logit Model of Purchase Decision for Child				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
Constant	1.225 (1.030)	0.573 (0.913)	0.898 (0.958)	0.338 (0.924)
Age	-0.122** (0.048)	-0.093** (0.045)	-0.120** (0.046)	-0.082* (0.046)
Parent's Age	0.014 (0.012)	0.021* (0.011)	0.020* (0.011)	0.019* (0.011)
Male	-1.848** (0.735)	-1.858*** (0.694)	-1.942*** (0.715)	-1.900*** (0.699)
Helmet Law - Yes	1.905*** (0.195)	1.877*** (0.183)	1.866*** (0.188)	1.887*** (0.184)
Helmet Law - Don't Know	1.012*** (0.224)	0.946*** (0.208)	0.896*** (0.212)	0.956*** (0.209)
Household Income Minus Price ($1000)	0.01*** (0.003)	0.01*** (0.003)	0.01*** (0.003)	0.01*** (0.003)
Black	-2.578** (1.035)	-2.882*** (0.976)	-3.00*** (1.002)	-2.802*** (0.972)
White	-1.528* (0.882)	-1.903** (0.828)	-1.912** (0.853)	-1.823** (0.828)
Parent Rides	0.631*** (0.164)	0.551*** (0.154)	0.570*** (0.158)	0.540*** (0.155)
Highschool	0.764** (0.319)	0.673** (0.297)	0.815*** (0.304)	0.712** (0.302)
College	1.303*** (0.323)	1.247*** (0.298)	1.298*** (0.305)	1.301*** (0.304)
Fatal Head Injury Risk	199886** (82924)	195097** (78693)	210878*** (80635)	189992** (79207)
Non-Fatal Head Injury Risk	254.2** (129.4)	286** (122.4)	276.3** (125.2)	305.9** (123.1)

Table 2
Econometrics Results for Logit Model of Purchase Decision for Child

Variable	(1)	(2)	(3)	(4)
Days Ridden	-0.016 (0.027)		-0.001 (0.007)	
Temp	-0.009* (0.005)			
Days Ridden * Temp	0.0003 (0.0004)			
Appearance Factor				9.810 (863.3)
Comfort Factor				13.398 (825.1)
Number of observations	1984	2159	2103	2114
Likelihood Ratio	232.724	238.397	233.163	247.622

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